constituent substances, and this, it is thought is due to the more complete coating effected by the mixture because of its better flowing qualities. The one to five mixture is equally as good as the one to one and much less expensive.

The increase in crop obtained by the applications is about 200 per cent. In the other tests the increase ranged from barely perceptible when the bud cutting on the check was low to more than 100 per cent when it was high.

The returns at Cologne, while larger than those obtained elsewhere, are due to the maintenance of a more complete coating of the buds during the critical period, and should be susceptible of being duplicated or bettered when sufficient care and intelligence are employed.

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## LITTLE KNOWN WESTERN PLANT LICE. II

By W. M. Davidson, *U. S. Bureau of Entomology, Walnut Creek, Cal.*[1]

*Vacuna dryophila* Schrank (?). Figs. 16, 1 to 3.

*Chaitophorus* sp. Davidson, Jour. Econ. Ent., Feb., 1914, p. 128.

The apterous vivipara (erroneously thought at the time to be the stem mother) and young sexual were described by me in 1914 under the name of *Chaitophorus* sp., the young sexual somewhat resembling the spinous dimorphic forms found in the *Chaitophorinæ* in species living on maple and box elder. However, after other forms had been encountered it became obvious that the species was widely separated from *Chaitophorus*, and that it belonged to a small group in which the sexes are small and wingless and in which the true female deposits normally but one winter egg. In their sexual characteristics the *Vacuninæ* approach the *Schizoneurinæ* and *Pemphiginæ* but the habits of the other forms more nearly approach those of the *Chaitophorinæ* and the *Lachninæ*.

In the species with which we are concerned the stem mothers hatch about the beginning of March, at a time when the buds of the oak have not perceptibly swollen. The lice feed at the base of a bud and are at first dark olive green with erect white spines. As they grow they become darker and mature individuals are brown. They remain at the base of the bud and produce a generation of young which become apterous viviparæ and in turn give birth to the third generation. Some of the third generation become nymphs and later acquire wings. The second and third generation apteræ are bright green with antennæ and legs pale hyaline greenish white. The pupæ are similar in color

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and have in addition, at the base of the abdomen, two pairs of conspicuous yellow areas. The second generation matures about the second week in April and the third generation about the beginning of May. The nymphs are apparently not abundant and the single winged specimen I have collected may be described as follows:

Head, thorax, scutellum, sternal plates dark olive green, shining; antennæ and legs pale yellow hyaline, the two basal antennal joints dark olive green as the head; eyes red, compound; prothorax, wing insertions, abdomen yellowish-green; cornicles brown; cauda pale green; wing veins brown, narrowly bordered dusky; beak pale, apical third dusky; head evenly rounded in front as in apteræ; eyes and ocelli prominent. At the base of each antenna, intad, on the margin of the head is an acute pale tubercle of about the size of the central ocellus. Antennæ about half the body in length, 5-jointed, III sub-equal to IV and V combined; beak reaches third coxæ; thoracic lobes partly fused; wings carried horizontal, third discoidal vein unbranched in one wing and with a branch at apex in the other; hind wing with one discoidal; cornicles pore-like; cauda small, globular; abdomen robust. Measurements (balsam mount); length body .75 mm.; width body .36 mm.; antennæ .39 mm. Date of collection, May 16, 1915.

The above-described individual was submitted to Mr. A. C. Baker, U. S. Bureau of Entomology, Washington, D. C. Mr. Baker has pointed out the following differences between it and European specimens of *V. dryophila* in the U. S. National Museum collection: Typical *dryophila* has four circular sensoria and about 12 prominent hairs on antennal III, while the California specimen has no sensoria and not over 3 hairs; the thorax of typical *dryophila* is without any indication of lobes, whereas the California individual has the thorax partly divided into lobes.

The spring colonies of apteræ are greedily attended by ants and from their very gregarious habits fall easy prey to predators. After May the only forms remaining are the young sexuals which are deposited by the alatæ of the third generation during May. The spring colonies feed both on the stalks and on the lower leaf surface but the sexes only in the latter location. The sexuals are often quite abundant and are not so gregarious as the spring forms. Although deposited in May they do not cast their first skin until September and are not mature until the latter part of November.

The full-grown insects are of a pale lemon color with greyish antennæ and legs, and the cornicles appear as brown-rimmed pores. They are armed with thick spines. The eyes are simple, of 3 facets. The last antennal joint is markedly longer than the penultimate and about as long as III. It bears a fringed sensorium. The beak reaches to the second coxæ. The male measures about .51 mm. by .23 mm., antennæ .21 mm., the female about .85 mm. by .44 mm., antennæ .23 mm. After mating the female deposits a single egg in the axils of the buds. This egg is oval, black, lightly covered with silvery filaments previously noticeable on the sides of seventh and eighth abdominal segments of the female.

This species I have observed at Walnut Creek, Calif., on the valley oak (*Quercus lobata* Née) from the spring of 1913 to 1916. The insect is quite local and does not appear to spread appreciably, perhaps due to the scarcity of alates. In California there is a species on alder (*Alnus rhombifolia* Nutt.) which apparently belongs to the same group of aphides and of which I have thus far taken only the ovipara (Stanford University, Nov., 1914, and Hopland, Sept., 1915). In color and shape this resembles the oak species but it has a different arrangement and structure of spines.

*Callipterinella annulata* Koch. Figs. 16, 4 to 8.

*Chaitophorus annulatus* Koch. Die Pflanzenlausen.
*Chaitophorus betulæ* Buckton. Brit. Aphid. II.
*Chaitophorus betulæ* (Buckton) Gillette. Journ. Econ. Ent., Aug., 1910.
*Callipterinella annulata* (Koch) Van der Goot. Zur Systematik der Aphiden. Tijd. voor Ent., 1913.

Considerable doubt has arisen about the placing of this species and in 1913 Van der Goot erected the new genus Callipterinella to contain it and *Callipterus betularius* Kalt. This latter species I have never seen but *annulata* has characters of *Myzocallis* of the Callipterini (cornicles, antennal armature, etc.) and others of *Thomasia* of the Chaitophorini (cauda, non-capitate hairs, length of antennæ, etc.), but it cannot rightly belong to either. Van der Goot has placed it in the Callipterini which seems its right place, and whether or not his scheme of genera be accepted *in toto* there can hardly be any doubt concerning the validity of the genus *Callipterinella*, as far as the species *annulata* is concerned. The synonymy of Buckton's *betulæ* is taken from Van der Goot.

According to Gillette (J. E. E., Aug. '10) this species has a wide distribution in America for it is reported by him from Portland, Lansing, Albany, Geneva and Denver. In California it occurs together with the European *Euceraphis betulæ* on imported Birch (*Betula alba*) infesting foliage and shoots. The prevailing color is reddish-brown.

Apterous viviparous female (Fig. 16, 4). Reddish-brown: body clothed with numerous long non-capitate hairs; many dark brown transverse bands and lateral sub-circular and sub-quadrate areas occur on the dorsum: antennæ basally light-colored, apically dark brown, half as long as the body, clothed with short hairs; III with 4 to 5 oval sensoria in a row on the slightly swollen basal half: hairs on forehead as long as antennal segments I and II combined: legs quite hairy; tarsi dusky, rest concolorous with the body ground color: cornicles dark brown, sub-quadrate, .071 mm. long, .068 mm. wide at base: cauda hardly constricted basally, rounded, dusky, .070 mm. long: anal plate dusky, emarginate: beak stout and short, reaching anterior margin of second coxæ. Length of body 1.83 mm. Width of body (fifth abdominal segment), .71 mm. Antennæ; III .39 mm., IV .20 mm., V .17 mm., VI .10 mm., filament .19 mm.

Oviparous female (Fig. 16, 5). Light reddish-brown: body clothed with numerous long non-capitate hairs: head, prothorax and a broad transverse band on each of the remaining body segments dark brown; each of these segments has also a pair of lateral sub-quadrate brown areas, noticeably large on mesothorax, metathorax, and abdominal segment 8: antennæ about half as long as the body, dark brown, basal seven-eighths of III and basal half of IV pale yellow; III thickened basally and on this swollen portion are 3 to 5 oval sensoria in a row: legs dark brown, base of femora and middle part of tibiæ pale yellowish-brown; legs hairy: under side of abdomen marked with rows of small faint brown spots: beak pale, apex brown; barely reaches second coxæ: cornicles dark brown, subquadrate, .093 mm. long, .082 mm. wide at base; cauda pale reddish brown, obtusely conical, .066 mm. long: anal plate rounded: hind tibiæ bear on their slightly swollen basal half a great number of small circular sensoria: length of body 2.48 to 2.89 mm. Width of body (fifth abdominal segment) 1.07 to 1.22 mm. Antennæ; III .54 mm., IV. 29 mm., V. 21 mm., VI .15 mm., filament .27 mm.

Male (Fig. 16, 6–8). Ground color reddish brown. The single specimen I have is almost destitute of hairs except on the legs and at the extremity of the body: brownish transverse bars, not reaching margins, occur on disk of abdomen and spots of similar color occur on lateral margins: abdominal segments 1 to 5 have 2 pairs of small lateral tubercles, the inner pairs the larger: antennæ almost as long as body; on both there are 17 circular sensoria on III and these occupy in a row the entire length of the joint; V and VI have each an unusually large apical sensorium and VI has besides about 3 small ones; the sensoriation similar to that of the male of *Calaphis betulaecolens* Fitch in that the fourth joint is unsensoriated: beak reaches halfway between second and third coxæ: veins of the wings thick and somewhat narrowly clouded; stigmatic vein obsolete for its basal half: legs with short hairs: cornicles dusky brown, subquadrate, .07 mm. long: cauda rounded, slightly constricted basally, grey: anal plate emarginate: length of body 1.92 mm. Width, maximum .73 mm. Antennæ; III .52 mm., IV .29 mm., V .24 mm., VI .12 mm., filament .24 mm.

Male and apterous female taken the first half of October, 1913, at Oakland, Cal. Oviparous females taken October 23, 1915, at Walnut Creek, Cal.

*Aphis neo-mexicana* Ckll. var. *pacifica* var. nov. Fig. 16, 9 to 14.

Alate viviparous female (Fig. 16, 9–11). Light green: head and prothorax olive-grey: antennæ black: thorax brownish-olive: cornicles and cauda light grey: beak pale, tip black: abdomen light green with lateral rows of circular black spots: veins of wings brown, narrowly clouded; stigma and insertions greenish: legs yellowish-brown, tibial and femoral apices and tarsi black: sterna black: anal plate grey: eyes dark red. Antennæ not on frontal tubercles, reaching to the fifth abdominal segment; filament longer than III; IV and V sub-equal; sensoria circular, of irregular size and those on III not disposed in a row, 11 to 14 on III, 4 to 6 on IV, usual apical on V and VI except that occasionally on V there are 1 or 2 extra about the middle of the segment: prothorax bears a pair of lateral tubercles: beak reaches to third pair of coxæ: second fork of third discoidal vein slightly nearer to the wing apex than to the first fork: seventh abdominal segment bears a pair of lateral tubercles: cornicles imbricate, slightly enlarged at base, longer than antennal joint IV but not as long as III: cauda of the usual shape of the genus, rather large, two-thirds the cornicles in length, armed with spines. Length of body 1.2 mm. to 1.3 mm. Maximum width .46 mm. to .56 mm. Wing expanse about 5 mm. Beak .46 mm. Cornicles .17 mm. to .2 mm.

Cauda .14 mm. Antennæ; III .21 mm. to .26 mm., IV .14 mm. to .17 mm., V .14 mm. to .17 mm., VI .11 mm. to .12 mm., filament .27 mm. to .31 mm.

Apterous viviparous female (Fig. 16, 12–14). Light green: antennæ, legs, cornicles, cauda hyaline greenish white; knees briefly and antennal VI entirely, dusky grey; eyes red: prothorax with prominent lateral tubercles: a pair also on seventh abdominal segment: beak pale, apex dusky, reaching beyond second coxæ. Length of body 1.23 mm. Width .67 mm. Cornicles .27 mm. Cauda .19 mm. Antennæ; III .16 mm., IV .14 mm., V .13 mm., VI .11 mm., filament .21 mm. The pupa is pale green with light-colored wing-pads.

This species was taken at Walnut Creek, Cal., curling terminal leaves of cultivated red currant in June, 1915. What appears to have been the same species was collected at San Jose, Cal., in May, 1912, on the same host. Mr. A. C. Baker, Washington, D. C., to whom specimens were sent, compared these with the type of *A. neo-mexicana* Ckll. and has written that the two varieties are very similar except that the California specimens have a longer distal antennal joint and slightly larger sensoria. The species is evidently near *Aphis sanborni* Patch and *Aphis ribis* Sanborn. It differs from the former in the comparative lengths of antennal joints and cornicles and from the latter in its comparatively longer beak and in the sensoriation. The infestation at Walnut Creek was confined to a single small currant bush and was first noticed about the end of May. Before the end of July the lice had been entirely wiped out by predators. Late in the fall a few oviparæ of a species of *Aphis* were observed on the bush, but the species could not be identified. At the same time migrants and sexes of *Myzus cynosbati* Oestlund occurred on the plant.

Type: U. S. National Museum Catalogue No. 20072.

*Myzus ribifolii* sp. nov. Fig. 16, 15 to 28.

Stem mother (Fig. 16, 15, 16). Stout and broad; ground color pale green; head, band of prothorax, thorax, and disk of abdomen brownish-black; the lateral margins of the abdomen and that part of the disk caudad of the cornicles (except a median band on seventh segment) pale green; the dark color predominates; under side of body pale green; cornicles, tip of cauda, coxæ, trochanters, knees, tibiæ and tarsi dark brownish-black; antennæ pale green, articulations dusky brown: antennæ on obvious frontal tubercles which are slightly gibbous; first joint rather obscurely toothed; antennæ from half to two-thirds the length of the body; III longer than the filament of VI, but shorter than whole of VI; V slightly exceeding IV; beak pale, tip dusky, reaches to second coxæ: cornicles imbricated for their entire length, slightly thickened at base: cauda slightly shorter than cornicles, ensiform, the apex rather bluntly rounded: hairs on forehead and antennæ long, those on body and legs shorter, in all places moderately abundant, very indistinctly capitate. Length of body 2.13 mm. Width (metathorax) 1.30 mm. Cornicles .21 mm. Cauda .19 mm. Beak .50 mm. Antennæ; III .27 mm. to .29 mm., IV .16 mm., V .17 mm., VI .09 mm., filament of VI .23 mm.

Stem mothers were collected at Redwood Canyon, near Walnut Creek, Cal., towards end of March, 1915, in curled and blistered foliage

of the wild flowering currant (*Ribes glutinosum* Benth.). In most of the curled leaves but one insect occurred and it is presumable that a single individual was able to bring about the malformation. The leaves bore noticeable yellow and pink blisters recalling those caused by *Myzus ribis.*

Apterous viviparous female, second generation (Fig. 16, 17–19). Yellowish-green in ground color, marked very much as is the stem mother, but some individuals lack the dark brown markings and have only orange-colored areas about the base of the cornicles; antennæ basally pale, apically dark brown; cornicles and cauda brownish-black; coxæ and tibiæ dark brown; 4 anterior femora greenish-yellow; posterior femora black, the basal half greenish-yellow; tarsi dark brown; antennæ reach to base of cornicles, relatively longer than those of the first generation but similar in structure; III bears on its basal half 4 to 7 sensoria; IV is longer than V; III and filament of VI sub-equal: cornicles and cauda much as in stem mother, shape of former variable as base is sometimes constricted and at other times widened: beak reaches third coxæ: hairs as in stem mother. Length of body 1.96 mm. to 2.13 mm. Width (metathorax) .97 mm. to 1.07 mm. Cornicles .21 mm. to .24 mm. (average .23 mm.). Cauda .20 mm. Beak .53 mm. to .57 mm. Antennæ; III .33 mm. to .37 mm., IV .19 mm. to .23 mm., V .19 mm. to .21 mm., VI .07 mm. to .09 mm., filament of VI .33 mm. to .34 mm.

Taken during March, April and May, 1914 and 1915, in curled leaves.

Alate viviparous female (Fig. 16, 20–22). Apple green; head, thorax, antennæ, cornicles, apex of cauda, black or dark brown; legs yellowish-green; apical half to two-thirds of femora, tibiæ and tarsi, blackish; base of antennal III pale; transverse rows of dark brown spots occur on disk of abdomen and lateral spots are sometimes present: Antennæ longer than the body, their structure as in stem mother, III with from 29 to 35 tuberculate circular sensoria the whole length of joint, V and VI with usual apical sensoria; hairs numerous, about equal in length to the width of the joints: eyes dark red: beak reaches third coxæ: wings as in *Myzus;* stigma and insertions light green; first and second discoidals narrowly clouded; second fork of third discoidal nearer wing apex than first fork: legs rather long and narrow: cornicles as in stem mother but considerably longer and not thickened basally: cauda as in apterous forms: hairs of body are longer than in the apterous forms. Length of body about 1.60 mm. Width (mesothorax) .67 mm. to .69 mm. Cornicles .25 mm. to .27 mm. Cauda .20 mm. Beak .57 mm. Wing expanse 6.57 mm. to 6.66 mm. Antennæ; III .59 mm. to .66 mm., IV .33 mm. to .36 mm., V .30 mm. to .35 mm., VI .08 mm. to .10 mm., filament of VI .50 mm. to .57 mm.

Collected with apterous forms during March, April and May, 1914 and 1915.

Oviparous female (Fig. 16, 23–26). Pale whitish-yellow; eyes bright red; the dark markings of the viviparous forms appear very faintly on the dorsum of the body in the ovipara; coxæ, cornicles and cauda light grey; tarsi grey; joint VI of antennæ grey, rest pale: antennæ half the body in length; joint III with 3 to 4 circular sensoria on basal half; V and VI with usual sensoria; V slightly longer than IV; filament of VI longer than III; frontal tubercles as in other forms; hind tibia is dilated for its basal half and bears about 26 sensoria on this portion: cornicles and cauda as in alate

female but shorter. Length of body 1.64 mm. to 1.80 mm. Width (third abdominal segment) .83 mm. to .90 mm. Cornicles .20 mm. Cauda .15 mm. to .17 mm. Beak .40 mm. Antennæ; III .25 mm. to .26 mm., IV .13 mm. to .14 mm., V .14 mm. to .15 mm., VI .07 mm., filament of VI .26 mm. to .29 mm.

Collected in curled foliage May 7, 1914.

Male pupa. Brick red; wing-pads whitish. Taken May 7, 1914.

Male (Fig. 16, 27, 28). General color red; head, thorax, cornicles, cauda, sterna, black; antennæ black, base of III light red; legs pale yellowish-red, knees broadly, tarsi, apical half of tibiæ, black; stigma and insertions of wing light green; veins black, discoidals I and II narrowly clouded and thickened; eyes dark red: antennæ much longer than body, on obvious frontal tubercles; II obtusely toothed; filament of VI longer than III; IV longer than V; sensoriation III 40 to 44 circular tuberculate the whole length of joint, IV 10 to 12 dispersed throughout joint, V 8 to 14 (besides apical) disposed as on IV, VI 1 to 2 besides apical group: cornicles imbricated, cylindrical: cauda ensiform: beak reaches third coxæ, pale, apex dusky: legs long and narrow: abdomen red, with lateral brown spots and faint brown markings on disk: whole body clothed with hairs, of which there are several rows. Length of body 1.32 mm. to 1.54 mm. Width (mesothorax) .58 mm. to .60 mm. Cornicles .18 mm. to .19 mm. Cauda .16 mm. Expanse of wings 5.40 mm. Beak .49 mm. Antennæ; III .59 mm. to .64 mm., IV .30 mm. to .40 mm., V .27 mm. to .36 mm., VI .08 mm. to .11 mm., filament of VI .63 mm. to .68 mm.

Type: U. S. National Museum Catalogue, No. 20073.

Taken in curled foliage May 20, 1913, and May 7, 1914.

I have never located any winter eggs. The aphids are not to be found after the month of May and so I conclude that the winter eggs are deposited in this month and that they do not hatch until the spring following. The stem mothers must hatch as early as February as I have collected mature second generation individuals in the last week of March.

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## Explanation of Figure 16

1–3. *Vacuna dryophila* (?). 1: Alate viviparous (?) female, head and antennæ 2: Male. 3: Oviparous female, and last antennal joint (enlarged).

4–8. *Callipterinella annulata*. 4: Apterous viviparous female. 5: Apterous oviparous female, antenna. 6–8: Male. 6: antenna. 7: wing. 8: cornicle.

9–14. *Aphis neo-mexicana* var. *pacifica*. 9–11: Alate viviparous female. 9: antenna. 10: cornicle. 11: cauda. 12–14: Apterous viviparous female. 12: antenna. 13: cornicle. 14: cauda.

15–28. *Myzus ribifolii*. 15, 16: Stem mother. 15: antenna. 16: cornicle. 17–19: Apterous viviparous female. 17: head and antenna. 18: cornicle. 19: cauda. 20–22: Alate viviparous female. 20: antenna. 21: cornicle. 22: cauda. 23–26: Oviparous female. 23: antenna. 24: cornicle. 25: cauda. 26: hind tibia. 27, 28: Male. 27: antenna. 28: cornicle.

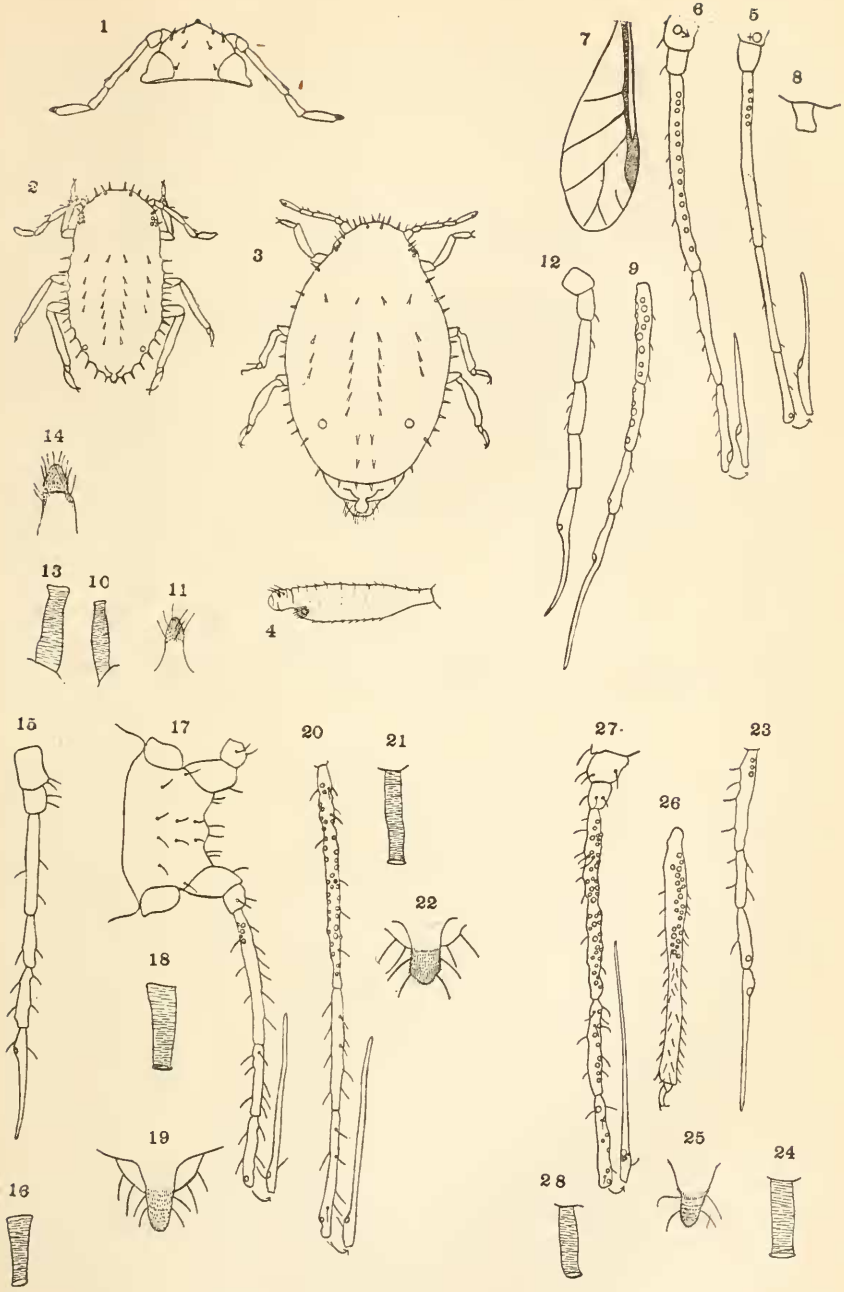


Fig. 16, see explanation on opposite page.